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THE SIOUX CITY BOOSTER STATION[1]

By Philip Carlin

The city of Sioux City, the second city in Iowa in respect to population, has a municipally owned water works, the construction of which was begun in October, 1884. On January 12, 1885, the 12 miles of water mains were flushed out and filled, and a 1,500,000 gallon reservoir was added during the year. By January 1, 1886, the income from the rentals was sufficient to meet operating expenses. The bonded debt of the works at this date was $133,390.89. This debt with all other obligations has been wiped out and the plant today is free from debt. As the population increased extensions were added until the length of mains has become 101 miles, ranging from 4-inch to 30-inch. In addition to this some forty miles of smaller pipe have been laid for temporary use.

The water supply is taken from drilled wells from 6 to 26 inches in size.

The pumping machinery consists of a vertical Holly triple expansion 6,000,000-gallon pump, a Snow cross-compound pump of 4,000,000 gallons capacity, two Deane compound condensing 2,500,000-gallon pumps, one American Well Works motor-driven 2,000,000-gallon turbine pump, and two Gould triplex 500,000-gallon pumps. The last are located at Leeds, a suburb, and operated separately from the city proper. The four pumping stations are in good condition and at no time in the last few years has there been any difficulty in furnishing an ample supply of good water with adequate pressures in the congested districts. At the present time the pressure is quite satisfactory in the higher districts. The average pressure maintained in the business district ranges from 90 to 110 pounds per square inch.

The motor-driven turbine pump has been furnishing the city 2,000,000 gallons per day from a 26 inch well, 315 feet deep, about two miles from the center of population. A duplicate installation has been contracted for and will be in operation in July, 1917. The water taken from these wells is delivered through two 24-inch mains to two reinforced concrete reservoirs at an elevation of 258 feet above datum. The capacity of these two reservoirs is 7,500,000 gallons to the overflow. These reservoirs furnish water to the city through two 24-inch supply mains.

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[1] Read at a joint session of the Illinois and Iowa Sections at Moline, Ill., October 10, 1916.

Some eighteen or twenty years ago the city council decided to extend the water mains to Morningside, a beautiful suburb of the city which is now experiencing a rapid growth. A growing city is destined at some time to be perplexed with complaints that the water pressure in the distributing system is not sufficient, notwithstanding the fact that the quantity of water is ample to supply all needs. Such complaints come sooner to cities with a rapid growth, as was the case at Sioux City, whose population has increased from 33,000 at the time mentioned above to 63,000 at the present writing. When cities grow, the pipe lines must of necessity be extended, and as the draft, length of mains and velocity increase the pressures will naturally decrease. It was decided by the council to lay a 10-inch main a distance of about four miles into the center of this suburb with branch lines of 6 inch pipe extended to the outskirts. The elevation along the center of this district will average 164 to 170 feet above datum. The elevation at the reservoirs being 264 feet, you will readily see that the pressures at these points would be very light. Recording gauges were placed on fire hydrants in the center of this district, which showed pressures of 22 to 31 pounds per square inch. After deciding that such pressures were not sufficient to meet the requirements in case of large fires, the water officials began devising some means whereby the difficulty could be remedied. A consulting engineer was employed, who planned to install a sub-station about midway between the city proper and the extreme end of Morningside, at an elevation of 115 feet above city datum. Water was to be pumped from a 10-inch main into a steel stand pipe located 120 feet above the highest point in Morningside. This would be at an elevation of 260 to 270 feet above city datum. This plan seemed rather attractive, but its cost was an objection. The city finally abandoned this plan, and the following plan was adopted, and is now in use.

A sub-station is located at Helen and Dodge Streets at an elevation of 115 feet above city datum, where the static pressure is 50 pounds to the square inch. There were installed three two-stage

Buffalo centrifugal pumps with a capacity of 370 gallons each per minute, pumping against a head of 215 feet. When drawing at the rate of 1,000,000 gallons per day, the pressure will not drop below 15 pounds in the suction main. One of these pumps is used as a relay and is operated only in case of a large fire. These pumps are connected to a header, and the header connected to a 6 by 23-foot steel compression tank.

The pumps are motor driven and direct connected to three 40-horse power 500-volt motors making 1200 revolutions per minute. The power to operate these motors is furnished by the Sioux City Gas and Electric Company, and the Sioux City Service Company, connections to different lines being so arranged that if an accident should occur to one of them, power can be obtained from the other by manipulating the switches. A Cutler-Hammer regulator was installed by which the pumps are automatically started when the pressure in the discharge pipe falls below 50 pounds pressure, and are automatically stopped when the pressure reaches 100 to 105 pounds.

Water is pumped through a 10-inch discharge main to a distance of 3½ miles. The results are just the same as if we were pumping into a standpipe. When the standpipe is full, you stop pumping, and when the water is drawn down to a certain point, the pumps will automatically start pumping again. A 10-inch by-pass was connected to the 10-inch supply main with a 10-inch check valve placed on the line to Morningside, so that as soon as the pumps are started, the pressure is raised on the discharge side of the pumps. immediately closing the check and pumping under heavier pressure. This by-pass can be used in case the pumps are down for repairs.

On account of the rapid growth of this section of the city, which now has 1980 services, the 10-inch main has been taxed to its fullest capacity during the last year. The writer prepared plans for and has just finished laying a 12-inch main to this booster station to reinforce the present supply main. Pressure tests at fire hydrants at a distance of about one mile from this station, using four streams from 2½-inch hydrant connections with 1-inch nozzles, showed 65 to 75 pounds pressure at the nozzle with vertical streams thrown to a height of 84 to 90 feet. The compression tank, which takes the place of a tower and tank, is provided with a small motor-driven air compressor, by means of which the tank is at all times kept more than half full of compressed air, forming an expansive cushion which maintains the water pressure between the time of stopping and starting of the pumps.

The mechanical efficiency of the pumps was 75 per cent at the time of installation. Current is furnished at the flat rate of 2 cents per kilowatt-hour. The average monthly consumption of current is from 3000 to 3150 kilowatt-hours, while the bills for same range from $42 to $64 per month.

This booster plant was designed by F. W. Cappelen, of Minneapolis, consulting engineer, and installed during the term of office of G. B. Healy, commissioner of parks and public property. The present commissioner, J. M. Lewis, has recently ordered plans for the enlargement of the plant following along the same general lines of the original installation. The performance of the plant has been very satisfactory during the five years of continuous service through which it has passed.